



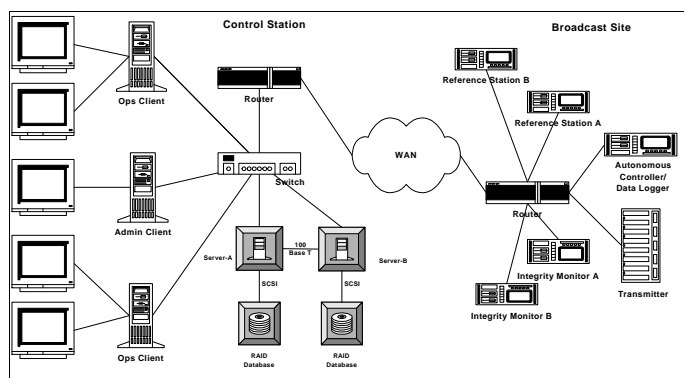
Radionavigation Bulletin

Fall/Winter 2001

Issue Number 37

Nationwide Differential Global Position System Control Station

Nationwide Differential Global Positioning System (NDGPS) requirements specify that NDGPS Broadcast Sites be monitored and controlled on a continual basis from a centrally located site and that these Control Stations have the capability to simultaneously monitor and control at least 200 sites. Scheduled for fielding in first quarter FY02, the Nationwide Control Station (NCS) culminates a 3-year \$1.5M development effort at United States Coast Guard Command and Control Engineering Center (C2CEN).



NDGPS Control Station

NCS has been designed adhering to Object Oriented design principles. To implement the greatest degree of flexibility, the application incorporates data-driven dynamic design, maximizing the use of a relational database to ensure data integrity and robust processing.

Implementing client-server architecture, NCS processing is easily allocated into the primary areas of its driving requirements to monitor and control. The Server portion of the application performs system Monitoring including all network communications and data storage. The Client, on the other hand, performs the Control functions, providing a user interface (UI) for watchstander initiated changes and System Status and Information display. The UI also provides watchstanders the capability to change site parameters and disable sites, i.e. turn off corrections, as circumstances warrant.

System requirements are captured and managed using Telelogic's Dynamic Object Oriented Requirements System (DOORS). Microsoft NT 4.0/SP 6.A (server

and workstation) is the Operating System, and Oracle 8i Enterprise Edition provides data storage/management and reporting capabilities. Developed using Microsoft's Visual C++ suite, code configuration management is accomplished using Merant's PVCS. The server platform is comprised of dual Dell 6450 Power Edge 4-processor computers, each having a 12-drive array of 18-GB disk drives. Client workstations are dual-processor Dell Precision Workstation 530's. Cisco's 3640 routers and 2924XL Switches provide network connectivity.

The client-server design minimizes and/or eliminates single points of failure and provides fault tolerant data storage. Features of note include the mirrored servers, redundant power supplies and processors within each server, redundant SCSI buses, controllers and cables, and Redundant Array of Inexpensive Disks (RAID) disk configuration. To provide contingency fail-over capabilities, the system relies on Legato's *Co-StandbyServer*™ to manage hardware and software failures.

NCS will be installed at the two operational sites, USCG Navigation Center in Alexandria, Virginia, and USCG Navigation Center Detachment in Petaluma, California. C2CEN also maintains engineering and support baselines at its Portsmouth, Virginia location. Each site has the capability to monitor and control the entire system.

— Connie Judy, C2CEN

Inside this bulletin:

From The Commanding Officer

Loran Data Communications

NDGPS RCA (GWEN) Transmitter Conversion

Civil GPS Service Interface Committee Notes

Modernizing The Loran-C Command and Control System

Pueblo, Colorado NDGPS Site Completed

From the Commanding Officer...



Some very important developments have taken place over the past few months that navigators worldwide should be aware of, not the least of which is the release of the Volpe GPS Vulnerability Report. This long awaited report, which was released on 10 October 2001, has prompted the Secretary of

Transportation to query the modes about impacts and he has required modal administrators to formulate a response by December. The report and the Secretary's direction to the modes are available on the NAVCEN website.

I'd like to focus on the Vulnerability Report because it highlights significant "niches in the armor" of GPS service provision. First let me state that GPS is a powerful capability that creates opportunities to navigate in conditions that would have never before been attempted. Picture the ore carrier in the approaches to the St. Mary's River that can confidently make its way through restricted waters in heavy rain or snow using an Electronic Navigation system...or the container ship that safely makes its way up the Cape Fear River towards Wilmington, NC while visibility is no farther than the bow of that ship. GPS provides the fuel into the eNavigation engine that makes it go. However, as the Vulnerability Report points out, the unsuspecting, or rather, incautious navigator could fall victim to severely limited options with respect to electronic sources of positioning information should a vessel depend on these systems in compromised conditions.

Our CG Cutter COs are always mindful of "conditions and contingencies" when making a transit through restricted waters. I considered conditions including but not limited to the harbor layout, the aids present, the weather and sea state, and so on...including deficiencies in the ship's ability to maneuver and navigate. The contingencies aspects concerned addressing the conditions in such a way as to mitigate or eliminate the possibility of error or equipment casualty ending up in an accident. Any navigator worth their salt will tell you to never depend on one source of positioning information.

So what am I getting at? Just this...be mindful that a growing dependence on GPS to fuel the charting system may relegate the navigator to the mariner's greatest no-no...one source. GPS can fail to provide the

necessary information due to interference or jamming. What is more insidious is the possibility that the fix solution accuracy may be eroded by Dilution of Precision (DOP). DOP is nothing more than a poor probability area of accuracy due to bad geometry, similar to poor bearing spread in a visual fix, except that in this case, the satellites are not spread optimally to give a good, tight solution. A DOP value that starts to climb above 6 means the accuracy required for use by charting systems is eroding past acceptable levels and other sources should be used to verify ship's position. If that fateful decision is being made to make that transit through restricted waters where visibility is limited, consider the options including delaying the transit or scoping possible bail out areas of opportunity should GPS degrade or fail.

A paper soon to be submitted to IALA by my colleague, Capt Curt Dubay, Chief of Radionavigation Division at CG Headquarters, captures succinctly the issues surrounding, in his words, "The Rise of eNavigation" with future trends in application. As stated in this paper, "critical maritime applications are adequately served by the existing navigation infrastructure" but it is not so clear for "critical emerging maritime applications". Efficiencies offered by ECDIS and AIS in manning and situational awareness will drive us towards new procedures and certification requirements that allow great utility in the MTS, but may also preclude legacy back up positioning sources from functioning in less than ideal conditions. I invite you to read this paper which is available on the NAVCEN website.

On a final note, I have asked the editor, Joyce Brown, to include two letters in this issue. These letters highlight the exceptional performance recognized at Lorsta's Seneca, New York and Gillette, Wyoming and are examples of the superior professionalism of all Coast Guard Loran personnel. Well done to all.

— CAPT Tom Rice, NAVCEN



**U.S. Coast Guard
Navigation Center
7323 Telegraph Rd.
Alexandria, VA 22315-3998**

Issue Number 37
Fall/Winter 2001

**ADM J. M. Loy
Commandant**

**VADM T. H. Collins
Vice Commandant**

**RADM T. M. Cross
Assistant Commandant for Operations**

**RADM K. T. Venuto
Director of Operations Policy**

**CAPT C. T. Lancaster
Chief, Office of Aids to Navigation**

**CAPT T. R. Rice
Commanding Officer, Navigation Center**

**Joyce M. Brown
Editor**

The Radionavigation Bulletin contains radionavigation system-related items for interested persons. This bulletin shall not be considered as authority for any official action and is non-record material. Views and opinions expressed do not necessarily reflect those of the Department of Transportation or the U.S. Coast Guard.

Contributors: Articles are welcome from all parties. Articles for publication should be sent to: Commanding Officer, USCG NAVCEN, 7323 Telegraph Road, Alexandria, VA 22315-3998. Articles may be submitted typewritten in 10 or 12 characters per inch, on an IBM-PC compatible 3.5 inch floppy disk (returned on request). The Radionavigation Bulletin staff reserves the right to edit all material submitted. Copyrighted material will not be accepted without the author's and/or publisher's written release/permission.

Readers: We welcome your comments. Critiques, complaints and distribution concerns should be directed to the above address.

Contents

From the Commanding Officer	2
NDGPS System Status Report	4
CG Electronic Charting Guidance Team.....	5
Loran Data Communications.....	6
NDGPS RCA (GWEN) Transmitter Conversion	7
Civil GPS Service Interface Committee Notes	12
Integrated ATONIS/Local Notice to Mariners.....	12
Modern. Loran-C Command & Control System.....	13
Letters of Exceptional Performance.	20
Operational Status of Loran Equip. Modern.....	22
Pueblo Colorado NDGPS Site Completed.....	28
USCG Navigation Center	29



Nationwide Differential Global Positioning System Status Report

-An Update-

The Coast Guard has been working hard toward the goal of coast-to-coast NDGPS coverage. Since our last report, we converted the following Air Force Ground Wave Emergency Network (GWEN) sites to the NDGPS network: Hawk Run, PA, Hagerstown, MD, Annapolis, MD and Albuquerque, NM (which is presently on air for testing). In addition the Coast Guard also constructed two new sites, one at Tampa, FL (relocating operations from nearby Egmont Key, FL), and the other at Level Island, AK (a new site to complete the coverage in southeast AK). These sites bring the total number of DGPS sites to 74.

In the coming months, the Coast Guard plans to convert several more GWEN sites near Bakersfield, CA (pending environmental clearance), Pueblo, CO, Medora, ND (pending funding), and Acushnet, MA (work at site has a projected start date of October 2001). There are also plans to build four new sites in the following locations: Pahoa, HI (complete coverage of Hawaiian Islands), Angleton, TX (will replace the Galveston site), Myton, UT (new construction site) and Pine River, MN (formerly known as Brainerd).

The latest timeframe for completing new GWEN conversions and new site construction is greatly dependent on a number of variables. These variables include budget issues, property access, and environmental clearances; however, we hope to complete Pueblo, Acushnet, Pahoa, Myton, and Pine River before the

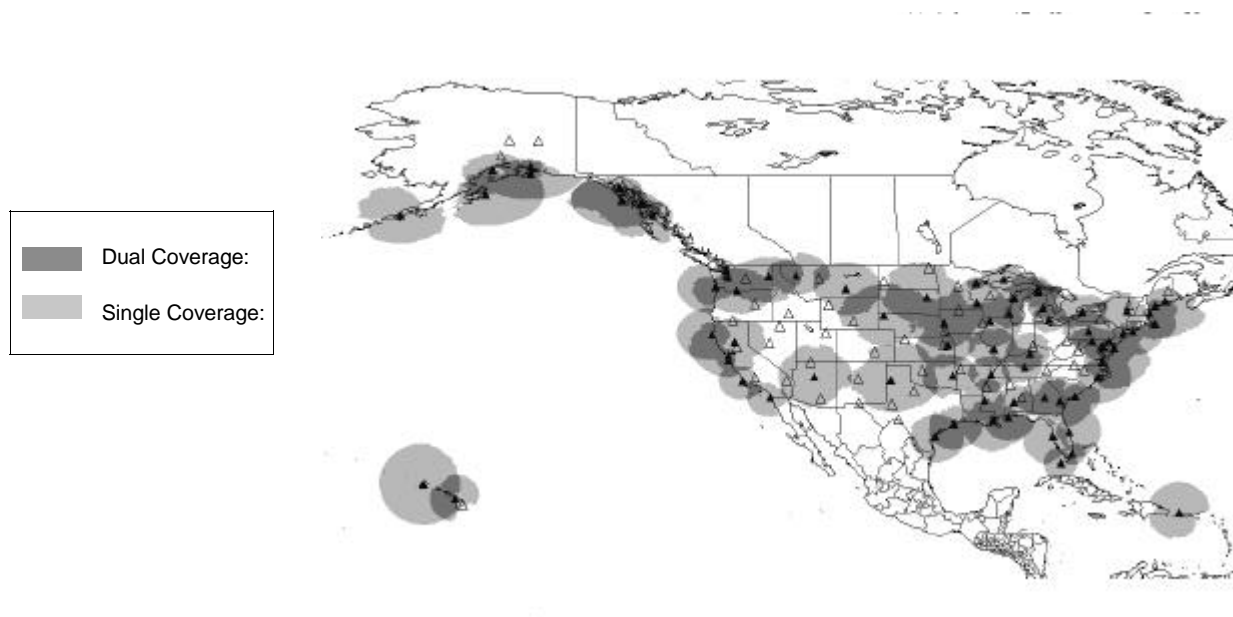
end of this calendar year. Acushnet and Medora will probably not be completed until next year.

"In addition to adding coverage, the NDGPS project engineers at the Command and Control Engineering Center in Portsmouth, VA are also developing a new control equipment suite of more versatile hardware and software. Parts of the new hardware have been installed, with watchstander training and operational familiarization scheduled for December. Full implementation of the Nationwide Control Station requires a new communications scheme which will be implemented in January 2002."

As I'm writing this article, Congress has not yet met in conference to decide on approval of the requested \$6M for FY02. If fully funded, this should provide for some combination of 3-5 sites depending on coverage priorities.

The below graphic represents the current predicted coverage plot for the United States. The darker areas represent the areas where there is dual DGPS coverage. Provided funding continues, we will continue our mission and build sites to provide dual coast-to-coast coverage.

— ENS Craig Lawrance, NAVCEN



Coast Guard Electronic Charting Guidance Team

-An Update-

The Coast Guard's Electronic Charting Guidance Team (ECGT) met for the third time at the Coast Guard Navigation Center (NAVCEN) on June 7th, 2001. What is the ECGT? After a year-long effort, the charter was signed in November of 2000 by RADM Cross (G-O), RADM Silva (G-S), and RADM North (G-M). (See "Electronic Charting Guidance Team" Spring/Summer 2001 Issue of Radionavigation Bulletin). Here is an excerpt of the charter:

"The Electronic Charting Guidance Team (ECGT) is the overarching organization to orchestrate electronic charting policy and initiatives in the Coast Guard. The Guidance Team will identify and track requirements, define the general processes, establish appropriate working groups, ensure that the Coast Guard has a unified and coordinated direction, and coordinate Coast Guard participation in the various forums addressing the aspects of electronic charting".

At the first meeting of the ECGT, it became clear that a more appropriate title for this team would have been the Electronic Navigation Guidance Team, as the scope of work is far more than just charts. However, the team decided that there was more important work to do than re-wording and rerouting the charter.

Who are the players? Representing the signatory directorates are the voting principals, CAPT Dan Deputy (G-OCU), Mr. Mike Sollosi (G-MWV), and Mr. Paul Arnstein (G-SCE). Other members include the Executive Secretary CAPT Tom Rice, CO of NAVCEN, CAPT David Glenn (G-OCC), CAPT Chuck Lancaster (G-OPN), and CAPT Bob Nutting, CO of C2CEN.

While the ECGT was formed as an internal Coast Guard group, it quickly became apparent that this work involves several other federal agencies. In fact, before the first formal meeting of the ECGT, the principals met with National Oceanic and Atmospheric Administration (NOAA) in January of 2001, which led to the Memorandum of Agreement signed on May 11, 2001. (See "Cruising Into The Future" Spring/Summer 2001 Issue of Radionavigation Bulletin). The National Imagery and Mapping Agency (NIMA) and the Army Corps of Engineers play a leading role in developing the exchange of marine information - a critical piece of the nation's infrastructure. The Navy has also recognized the importance of electronic navigation, and in late 2000 appointed RADM West as "Navigator of the Navy". Representatives of RADM West's office participate in both the bi-monthly ECGT meetings, and in the various working groups, which report to the ECGT. As

yet, there is no official "Navigator of the Coast Guard".

A critical short-term issue facing the Coast Guard for electronic navigation is developing the internal infrastructure we need to support this new way of navigating on our cutters and boats. Gone are the days when chart procurement meant paper charts supplied by the National Imagery & Mapping Agency (NIMA), the old Defense Mapping Agency (DMA), through cost-free unit accounts. Electronic charts are expensive to produce, and must be updated electronically. Units are using existing operating funds to pay for charts and updating services. The ECGT sponsored a 2003 Resource Proposal (RP) that would have created the required billets and funding stream. Unfortunately, there were other issues that were deemed more critical, the RP was deferred, and will be re-submitted next year for 2004. The result is continuing the Coast Guard tradition of doing more with less: we can't go back to paper navigation, so the money will be diverted from other projects or simply continue to be "taken out of hide".

At the June meeting, the ECGT looked at the existing state of electronic navigation in the Coast Guard. A result of leading the way in moving toward electronic navigation has been the proliferation of systems. Class by class, the Coast Guard's boats and cutters have differing operating requirements and parameters. A buoy tender has different needs than a 378, and so they ended up with different systems. The same is true throughout the fleet. Some of the issues this raises:

- (1) Multiple systems create multiple support requirements
 - (a) Engineering
 - (b) Parts
 - (c) Technician training
- (2) Multiple systems create the need for multiple operator training.
 - (a) Bridge crews are forced to learn a new system each time they report aboard a different class of cutter
 - (b) Accession points are unable to cover all systems
 - (c) C-schools are unable to cover all systems
 - (d) Majority of learning is thus forced to be on the job training

(continued on page 28)

Loran Data Communications (LDC)

This joint USCG/FAA project is developing a communication channel for broadcasting GPS integrity correction data known as Wide Area Augmentation System (WAAS) throughout the United States. WAAS is being developed for precise navigation throughout all modes of flight operations especially landings and take-offs. The USCG Loran Support unit partnered with USCG Academy, Stanford University, University of Ohio, and FAA contractors to research the communication capability of the LORAN signal for this purpose.

The LDC project reached a critical milestone in the proof-of-concept test after a remarkable year of research and design. Fall 2000 started with the team brainstorming the potential of a LORAN communication channel that is capable of throughput speeds greater than 250 bps. The old dusty books of the CG's Clarinet Pilgrim, Two Pulse Communication (TPC) and LORAN-D became the foundation for the newly engineered Pulse Position Modulation (PPM) and Super Interpulse Modulation (SIM) schemes. The team evaluated PPM and SIM for communication capability while ensuring that the LORAN signal maintained full navigation capabilities. The research led to the idea of Intrapulse Frequency Modulation (IFM) that resulted in a significant increase in data rate.

IFM starts like the normal LORAN pulse for the first 40 μ s. After the 40 μ s point, the frequency is changed twice in two separate stages. The two-stage modulation scheme requires the signal to remain at peak amplitude considerably longer to modulate the data. **Figure 1** is an example of the LDC signal actually transmitted from LORAN Station Tok. The top waveform is the "ideal" IFM pulse from a computer software program used as the transmitter drive waveform. The bottom signal is the LDC waveform transmitted from tube transmitter at LORAN Station Tok. The tube transmitter is a non-linear amplifier with inherent distortion that causes the difference in a transmitted versus "ideal" waveform.

Now for the milestone: An operational LORAN station transmitted the LDC signal that was successfully demodulated by a receiver aboard an aircraft flying over the interior of Alaska. This impressive feat was accomplished using the IFM scheme, a Reed-Solomon forward-error correcting code at the LORAN GRI of 4830. The system was able to transmit the full 250 bit WAAS message every second with some capacity to spare. Aircraft from the FAA and University of Ohio

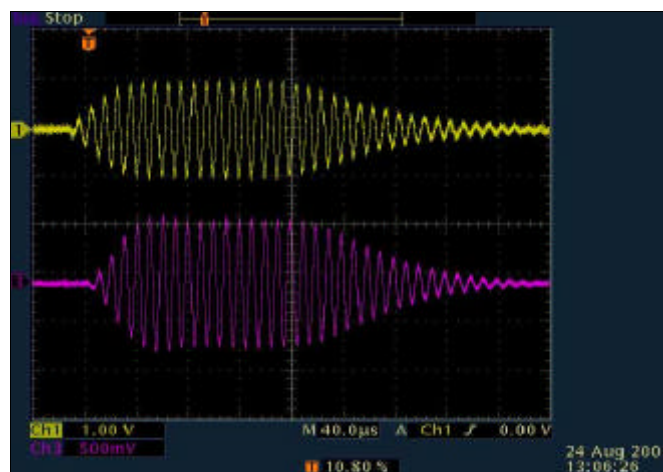


Figure 1: IFM signal recorded from LORSTA Tok

were used in the tests. These aircraft flew routes along the interior section of Alaska.

Their onboard receivers demodulated the signal and recorded channel performance parameters. The technical expertise and diligence of the crew of LORAN Station Tok produced nearly 25% more signal power than calculated prior to the tests. The results of all these efforts is that the LDC signal covered north to Purdow Bay, south to nearly Juneau, and west just past Fairbanks.

A technical paper was presented this past September at the ION-GPS Conference in Salt Lake City, UT. The paper outlines the aircraft routes, signal strengths of the LORAN signal, bit error rates, and WAAS message rejections. In addition, the paper explains, with supporting examples, how aircraft turns can block, or mask, the geo-stationary satellite signal. This masking event is a primary reason for exploring the LDC concept. A copy of this paper and previous technical papers summarizing the LDC project can be found on the LSU website, <http://www.uscg.mil/hq/lcu/webpage/lsu.htm>.

The LDC project continues to move forward this fiscal year. A study in the effects of the IFM signal on the navigation capabilities of legacy LORAN receivers is a primary goal. The team is developing a LORAN simulator for initial tests of LDC on legacy users. A second phase of legacy tests involves LSU transmitting the LDC signal for on-air evaluations. In addition, the LDC project is modifying LSU's solid-state transmitter hardware and software to transmit the IFM signal.

(continued on page 28)

NDGPS RCA (GWEN) Transmitter Conversion

RCA Transmitter (Low Frequency Power Amplifier)

The end of the cold war gave the Nationwide Differential Global Positioning System (NDGPS) program an unprecedented opportunity to bring new meaning to the phrase beating swords into plow shares. In this case the sword was a militarized transmitter and the plow share is a national navigational asset, which can guide the plows of precision agriculture applications through the fields.

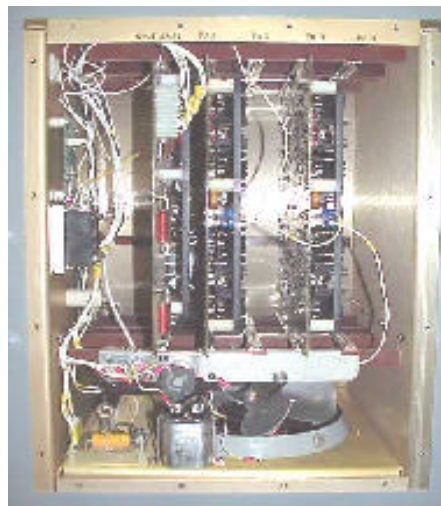
The decommissioning of the USAF Ground Wave Emergency Network (GWEN) system in the fall of 1998 gave the USCG the opportunity to use GWEN facilities as Differential (DGPS) broadcast sites. This program represented a large defense conversion to civil use whose synergies reduced the cost of providing nationwide DGPS coverage. In addition to reutilizing the towers and huts from the GWEN infrastructure it was determined to be economical to reutilize the existing RCA broadcast equipment rather than purchase new equipment.

The design of the GWEN transmitter was originally based on an AM radio transmitter. The USAF had the transmitter modified from continuous to pulsed operation and converted it to LF operation in the range of 150-175 kHz. In the USAF inventory it was designated the Minimum-Shift-Keying (MSK)-5SS Low Frequency Power Amplifier (LFPA). The AF transmitter designed called for three inputs and two outputs. The inputs were a MSK modulated carrier frequency, a transmitter key-on control signal, and 208 Volt 3-phase 60Hz electrical power. The outputs are amplified as a MSK modulated carrier frequency and a transmitter status signal.

Although very robust and designed to rigid military requirements the RCA transmitter was not able to fulfill unique DGPS requirements without extensive modifications. The feasibility of economically modifying the RCA transmitter was first demonstrated at the Appleton, Washington GWEN site in 1998. The Office of Research and Development of the Federal Railroad Administration spearheaded this first conversion to support DGPS coverage for Positive Train Control. Based on the successful conversion of the Appleton GWEN site the decision was made to fully use the RCA transmitter. C2CEN was designated as the lead agency to implement the transmitter conversion and follow on engineering efforts.

Major modifications made to the transmitter include:

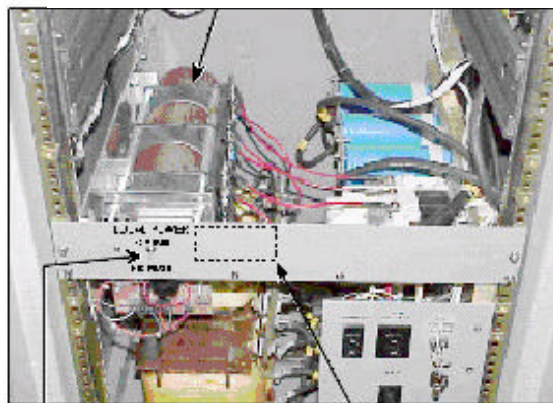
- Changing the band of operation to 283-325 kHz to match that of the radio beacon band.
- Changing the configuration to utilize only two power amplified cards instead of the original four. This will provide a maximum output power of 2.5 kW. The two removed power amplified cards will be used as on-board spares since the age of the RCA transmitter has created a scarcity of spare parts.



Power Amplifier Assembly Front View

- Adding a servo and manually controlled three-phase variable autotransformer to allow the output power of the transmitter to be controlled.

A2A1A2T1 VARIABLE AUTOTRANSFORMER

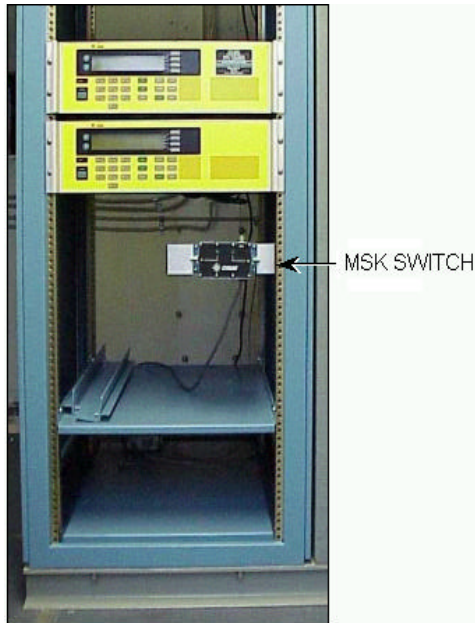


A2A1A1S1 POWER
CONTROL SWITCH

A2A1A3 (BEHIND PANEL)
POWER CONTROL BOARD

Variable Autotransformer

- Removing the pulse modulation assembly to allow for continuous operation. This eliminated the need for the key-on control signal and allowed for full use of built-in protection circuitry.
- Adding functionality to allow auto MSK switchover between drive signal sources should the source providing the signal fail. This is a temporary addition until the Remote Transmitter Control Interface (RTCI) is implemented.



MSK Switch

- Adding a high voltage disconnect circuit to remove -110 Vdc from the RF Amplifier boards while leaving -110 Vdc on the RF Input board.
- Adding an auto reset circuit. This will generate a reset signal once a minute during a transmitter detected fault condition. This is an interim circuit until the RTCI is fully implemented.

Signal Flow

From the transmitters input connections the MSK modulated RF is supplied to the RF Input Amplifier where gain is predetermined by setting of transformers and associated circuits. Output from the RF Input Amplifier then drives the two RF Power Amplifiers. Each power amplifier is connected to a tuned load. These loads are adjusted to balance the amplifiers. The balanced loads are joined using a combining transformer.



The combined output is then supplied to the 50-ohm transmission line through an output filter and load circuit.

The final configuration for the RCA transmitter and DGPS equipment rack without an RTCI implementation would be as follows:



RCA Transmitter without RTCI

Remote Transmitter Control Interface (RTCI)

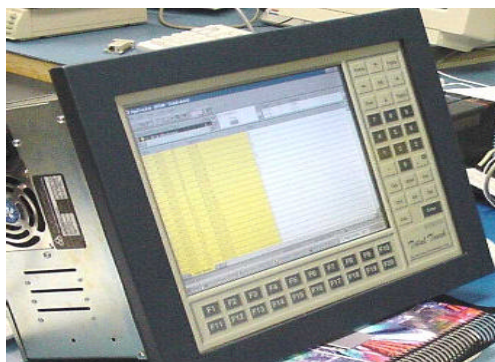
In addition to physically modifying the transmitter itself, remote monitoring and control functionality had to be added. Maritime DGPS sites use a SAC transmitter, which is controlled by means of an RSIM control drawer. Unfortunately, the RCA transmitter did not natively come with this capability.



Maritime SAC Transmitter RSIM Drawer

An RSIM Transmitter Control Interface was developed to provide the required capability to monitor and control the transmitter. A working prototype has been constructed and is currently undergoing tests at the C2CEN engineering mockup.

A rack mountable Industrial Computer with a Thin Film Transistor (TFT) flat panel display is used as a interface for the system. This computer utilizes a 600 MHz Celeron processor with 64MB of SDRAM. A Microsoft Windows NT operating system is used on an INX9000 computer manufactured by Ann Arbor Technologies (<http://www.a2t.com/>).



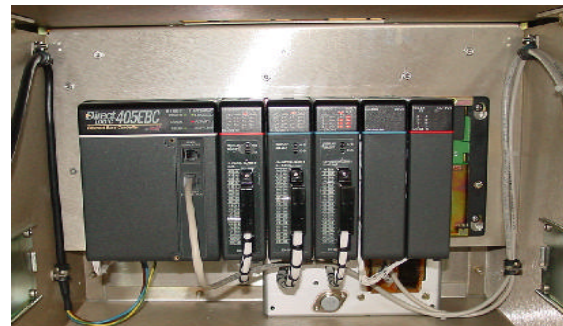
Industrial Computer

The Industrial Computer uses an Ethernet card to communicate with Programmable Logic Controllers (PLC) hardware. PLCs were first introduced in the late 1960s to replace relay circuits used in machine control.

We used PLC modules by Host Engineering Inc. (<http://www.hosteng.com/>) The main module used is H2-EBC. EBC stand for Ethernet Base controller. This module provides the Ethernet link between the PC and the PLC hardware. The EBC processes the analog and digital input signals, formats the I/O signals to conform with the Ethernet standard, transmits the signals to the PC-based controller, receives and translates the output signals for the PC-based controller software, and distributes the output signals to control the transmitter.

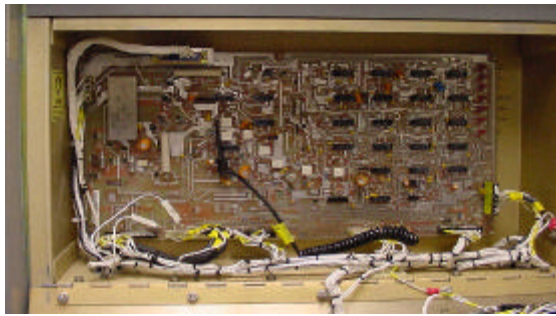
Other PLC I/O modules are also used:

- D4-32TD2: 32 pt. 12-24 VDC current sourcing output module
- D4-32ND3-2: 32 Pt DC Input Module 5-12 VDC
- F4-04 ADS: 4 channel isolated analog input module
- D4-08TER: 8 pt. 5-30VDC or 5-250 VAC output module



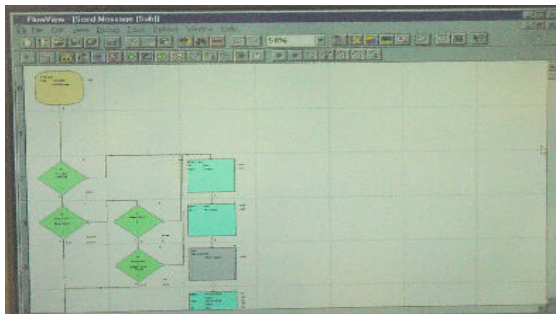
PLC Modules used

This PLC hardware then uses input/output modules to communicate with and control the transmitter. Most signals are obtained by tapping the control logic card of the transmitter. The control logic card controls and locally monitors the transmitter for fault conditions.



Tapping the control logic card for inputs

Think&Do Software (<http://www.thinkndo.com/>) was used as the application development environment to control the functionality of the PLCs. It uses a flow chart environment to program the controllers.



Flow chart environment used

The RTCI implementation has the capability to monitor the transmitter for various fault conditions, respond to those conditions as directed by the NCS control station and reset the transmitter if necessary, adjust the power of the transmitter, and control up to 24 binary control states (24VDC output) and 40 opto-isolated binary monitor states for site equipment not directly associated with the transmitter. This would include tower lights, temperature, humidity, intrusion detection, fire alarms, and generator monitoring.

RSIM Type 25 Messages (Broadcast Site Control and Status) are used to activate or deactivate these auxiliary control states. Type 25 messages are used to query the status of equipment at a site including the environmental sensors.

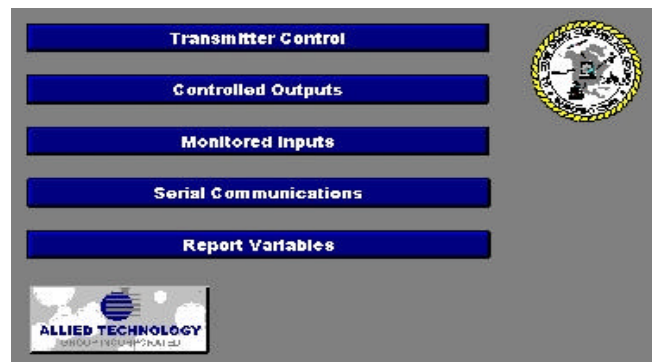
The RTCI will be able to change the output power of the transmitter when it receives a RSIM Type 24 message (Transmitter Control and Status) from the Control Status. It will do this by adjusting the servo controlled autotransformer.

The RTCI will respond with its serial number software version when queried with an RSIM Type 27 message (Equipment Logistical Parameters).

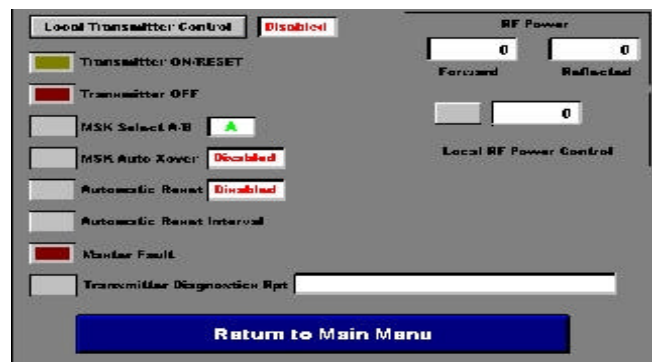
The RTCI will also fully utilize the following RSIM messages for remote control and monitoring of the transmitter:

- Message Type 1: RSIM Message # Query/Reporting Interval
- Message Type 2: RSIM Unrecognized Message Alarm
- Message Type 5: RSIM Diagnostic Report/Alarm

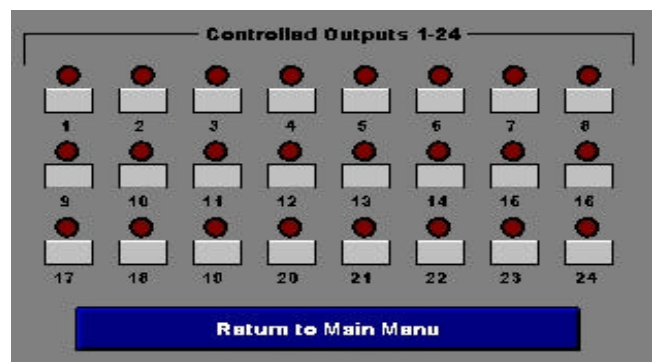
The RTCI program has 7 screens which are:



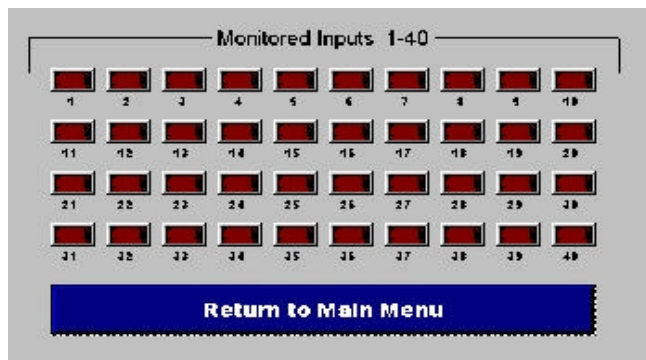
Main Screen



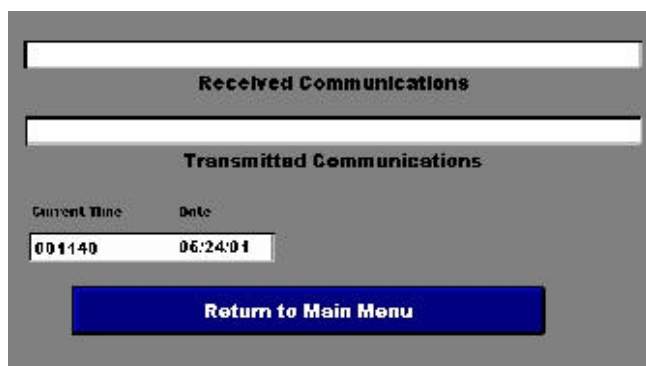
Transmitter Control



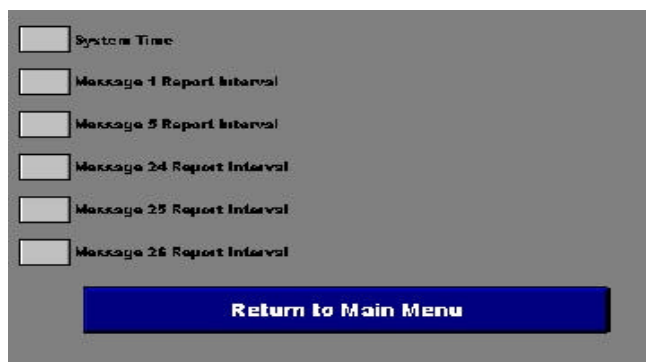
Controlled Outputs



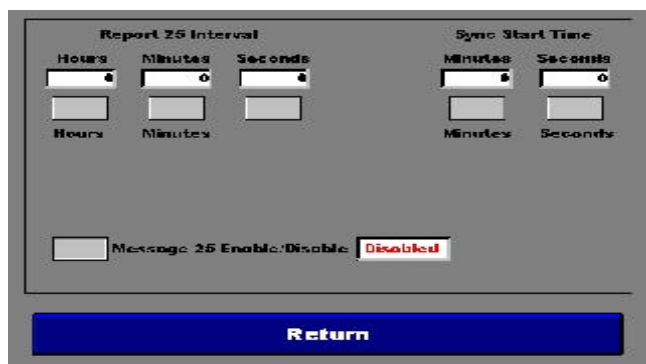
Monitored Inputs



Serial Communications



Report Variables



Changing Report Interval

When the RTCI module is fully implemented the need for the MSK and auto-reset switches are eliminated. The transmitter will then appear in the following configuration:



RCA Transmitter in a RTCI configuration

Extensive engineering effort proved that it was possible to economically convert a 20+ year-old transmitter to DGPS use while integrating state of the art monitoring and control functionality.

— LT Edward Haukkala, C2CEN

Civil Global Positioning System Service Interface Committee Notes

The Civil GPS Service Interface Committee held its 38th Meeting in Salt Lake City, Utah from September 9th through the 11th of 2001. Approximately 200 GPS users and policy makers discussed the current activities, for three days. Topics covered the latest developments and included the Volpe Report, the L2 Civil Replacement Code (L2C), and the PRN 22 event. Copies of the presentations are available on the NAVCEN website.

Leadership Changes

- Mike Shaw, Director, DOT Radionavigation Policy Staff became the Chair of the Civil GPS service Interface Committee on August 1st 2001, following Joe Canny's retirement from Federal Service.
- Mike Savill, Northern Lighthouse Board, Scotland, ended his term as International Subcommittee Chair at the 38th meeting. John Wilde of STASYS Corporation, United Kingdom, was elected as his replacement.

- Victor Zhang was elected to replace Lisa Nelson as the Timing Subcommittee Co-Chair.

39th CGSIC Meeting

The next meeting of the CGSIC will be held in Washington DC from April 17th through 19th 2002, which is the week prior to the FIG/ACSM meeting. Current developments and issues in GPS will be discussed. One panel at the meeting will focus on information requirements and discuss issues with the current information distribution systems. For updates on the agenda and location, visit the NAVCEN website at www.navcen.uscg.gov/cgsic.

The Coast Guard Service Interface Committee is open to anyone with an interest in Global Positioning Systems.

— Rebecca Casswell, NAVCEN

Integrated ATONIS/ Local Notice to Mariners Automation

The effort to automate the Local Notice to Mariners (LNM) has been named "Integrated Aid to Navigation Information System (IATONIS). The IATONIS will help districts generate the weekly and monthly LNM with automated tools instead of the current manually-intensive processes.

There are many benefits of the new IATONIS that are natural by-products of the attempt to automate LNM generation. For example, IATONIS will deliver the capability to host a public website. On this web site, the public will be able to generate an LNM as well as Light List updates. This capability will put information into the hands of mariners more quickly.

Additionally, we see IATONIS as a step forward in the transition to eCoast Guard. The Navigation Center already maintains LNM on its web site. Providing additional web-enabled applications such as LNM and Light List generation will allow the Coast Guard to move away from reliance on paper copies of these documents.

Currently, we are in the midst of IATONIS testing. If our current time schedule holds, the new system should be deployed internally to Coast Guard districts and Aid to Navigation units in summer/fall 2002. Once we are satisfied with the application internally (within Coast Guard), we will begin opening appropriate pieces of the application to the public. Our goal for public access is early in calendar year 2003.

— Marie Sudik, NAVCEN

Modernizing the Loran-C Command and Control System

-An Update-

Introduction: This article updates the reader on the ongoing Remote Automated Integrated Loran (RAIL) project to modernize the command and control capabilities for the Loran-C radionavigation system. The project plans to install RAIL equipment at the 24 U. S. Loran-C transmitting stations and make software enhancements to the control station's Loran Consolidated Control System (LCCS). Both systems work in conjunction to provide local and remote command and control capabilities. A brief history and status of the project is given and is followed by a description of the latest equipment that will be used to perform command and control operations.

Background: Back in 1997, the Coast Guard, in partnership with the Federal Aviation Administration, began an effort to upgrade and replace the aging suite of Loran-C Radionavigation equipment. The Loran Support Unit (LSU) started a project to replace the teletype (TTY) network system. Presently, we use the CG Standard Workstation II Unisys computer systems (SWSIIs) with the Loran Asynchronous Terminal Emulator software to operate the TTY network (circa 1990) at a Loran station. As the project developed, it became apparent that the equipment identified to replace the SWSIIs had much greater capacity and functionality than a TTY network. The scope of the project, renamed Remote Automated Integrated Loran (RAIL), was expanded to replace all outdated command and control equipment at 24 U. S. Loran-C transmitting stations.

The initial task to replace the TTY network shifted to replace the Local Site Operating Set (LSOS) command and control computer system. This system, as well as the current suite of Loran-C equipment, has worked well over the years, but is comprised of aging technology which is difficult to support. Also, many discrete pieces of equipment control a Loran-C transmitter making it difficult for a watchstander to get a comprehensive status of the station's equipment. RAIL will provide an integrated computer-based interface for all equipment at the Loran-C transmitting station, and further automate Loran-C operations.

Project Status. We are prototyping the RAIL system at five Loran stations.

- Lorsta Jupiter, FL
- Lorsta Seneca, NY
- Lorsta George, WA

- Lorsta Grangeville, LA
- Lorsta Carolina Beach, NC

The project will be completed in three phases. Implementation of the Phase 1 prototype is complete at the five field test sites. Phase 2 development is complete and will be installed in three stages. The first two stages have been installed at the test sites. The final stage incorporates the new Locus Casualty Control Receiver Set (CCRS) and will be installed in conjunction with the CCRS in FY02. When we complete all testing of the Phase 2 prototype at the test sites, then we will install the Phase 2 equipment at the 24 U. S. Loran-C transmitting stations. Phase 3 concentrates on removing LSOS and its sub-systems. However, Phase 3 development is dependent on the new Timing and Frequency Equipment (TFE) that is scheduled to arrive at LSU in FY02.

Each Phase of the project was designed to have minimal impact on operations while continuing a steady progression to completion. The Phase 1 prototype assumed five main functions at the Loran-C transmitting station.

- Control TeleTYpe (TTY)
- Bravo and Delta data strip chart recorders
- Archiving of data
- Interface for the Automatic Blink System (ABS)
- Interface for the Time of Transmission Monitor (TTM)

The first two stages of Phase 2 provided five additional functions at the Loran-C transmitting station.

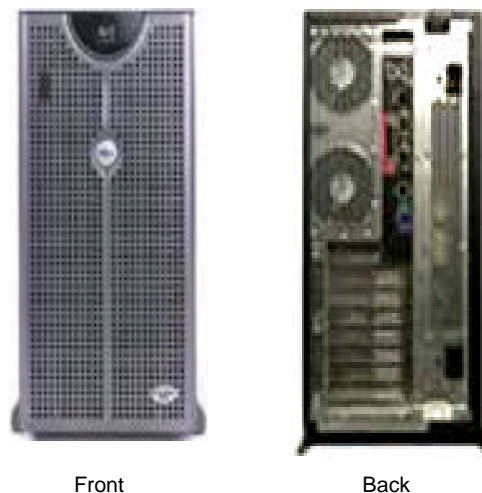
- Interface to the new Cesium Beam Clocks
- Interface to Backup Communications
- Replacement of the LSOS thermal printer
- Improved data parsing for the ABS and TTM
- Improved the data communications link between RAIL and LCCS

The final stage of Phase 2 will be installed simultaneously with the CCRS Locus receiver. Five pieces of equipment will be replaced and data parsing will be significantly improved.

- Replacement of the LSOS Time Interval Counter (TIC)
- Replacement of the Station TIC
- Replacement of the Electrical Pulse Analyzer (EPA)
- Replacement of the Asynchronous Communications PAD
- Replacement of the Data Broadcast
- Interface to the new CCRS Locus receiver
- RAIL collects all LSOS data

Having RAIL collect all LSOS data will ease the burden on the LSOS computer and LCCS remote control computer by eliminating the LSOS data round. However, LSOS will still handle logging and control functions until it is replaced during Phase 3 of the project.

Tools that do the Work: The computer that will perform these initiatives and eventually replace LSOS is the Poweredge 2500 (**Figure 1**) manufactured by Dell, Inc. The computer is a robust server with plenty of fault tolerance built into it. The chassis houses the processor, computer bus, required power supplies, expansion boards, and required backplane connections. The computer employs three front panel accessible 300-watt hot swappable power supplies, three hot swappable cooling fans, and three front panel accessible SCSI hot swappable hard disks for fault tolerance. The processor and its sub-components reside on an active motherboard configuration. The system also includes an 18-inch viewable color monitor and keyboard with touchpad. All equipment is installed in a standard 19-inch equipment rack. The computer's components are listed in Table 1.



Front Panel with Protective Cover Removed

Figure 1: Dell Poweredge 2500

A nice feature of the chassis is its tool-less design. No tools are required to gain access to the inside of the chassis or to replace any of its components. All front panel devices are removed by pressing the release mechanism on the front panel and removing the device (**Figure 2**). The technician's only requirement is to recognize the failed item from the front panel indicators and have the spare part in hand.

DESCRIPTION
<p>5U Rack mount enclosure Dell Powerededge 2500, including:</p> <ul style="list-style-type: none"> • 300 watt redundant ATX AC HOT Swappable power supplies • Three 200 CFM AC HOT Swappable fans • One front panel accessible 1.44MB 3.5" Floppy Drive • One front panel accessible 3.5" CD-Rom Read/Write • Three SCSI hot swappable 18.2 GB, 3.5" hard drives with RAID 5 Controller • Built-in watchdog equipment and process timer • Built-in 10/100 Ethernet • 7 Expansion PCI I/O slots • Pentium III, 933 MHz Central Processing Unit with 1 GB SDRAM • Microsoft Windows NT 4.0 Workstation Operating System • Rack mount keyboard with touchpad • 18 inch viewable rack mount color monitor

Table 1: Computer Components



Removing Hard Drive



Removing Power Supply

Figure 2: Removal of Front Panel Devices

The RAIL computer uses the Windows NT Version 4.0 Workstation operating system. The RAIL software is written in Microsoft Visual Studio Visual C++ and National Instruments Measurement Studio Lab Windows. The Graphical User Interface (GUI) is the centerpiece of the RAIL computer and allows the operator at the local site to command and control the Loran station's equipment. The Home Screen (**Figure 3**) gives a complete overview of the current status of Loran sta-

tion equipment connected to the RAIL system. The Home Screen displays all active alarms and commands, data, terminal windows, and allows access to equipment interface screens. A user can navigate to five equipment control screens or data charts from the Home Screen as well as a number of different terminal screens.

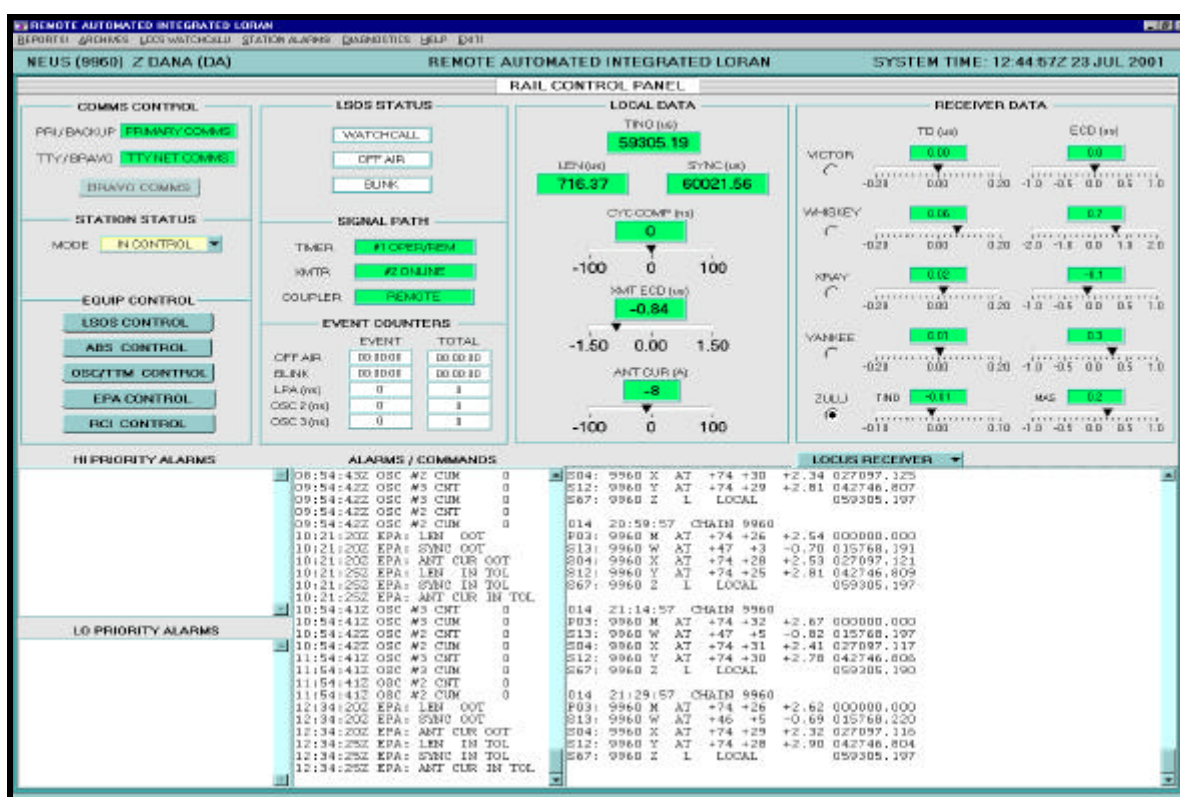


Figure 3: Home Screen

Equipment Control: A user controls equipment external to the RAIL CPU by navigating to the appropriate equipment control screen. This is done by pressing any of the buttons under "EQUIP CONTROL" section of the home screen. One example is the Electrical Pulse Analyzer (EPA) CONTROL button, which accesses a panel allowing the user to send commands to an expansion board installed inside the RAIL computer. This board is the GAGE Inc., Compuscope 1250 Digital Storage Oscilloscope

shown in (**Figure 4**). This oscilloscope analyzes the Loran-C transmitted signal via a feedback network and returns critical local signal data to the CPU. An example of this panel is shown in (**Figure 5**) along with an actual graph of the Loran-C pulse from the LSU's tube type baseline transmitter Operate RF signal return path.

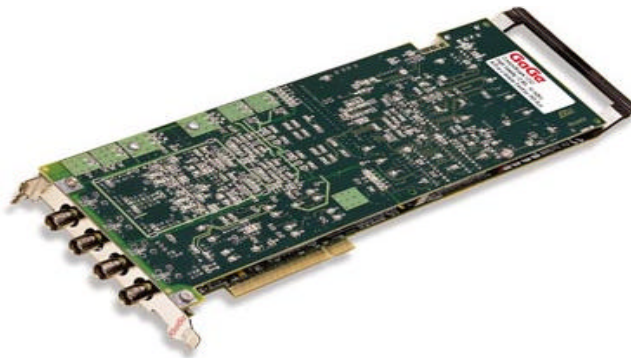


Figure 4: RAIL's Digital Storage Oscilloscope PCI Board

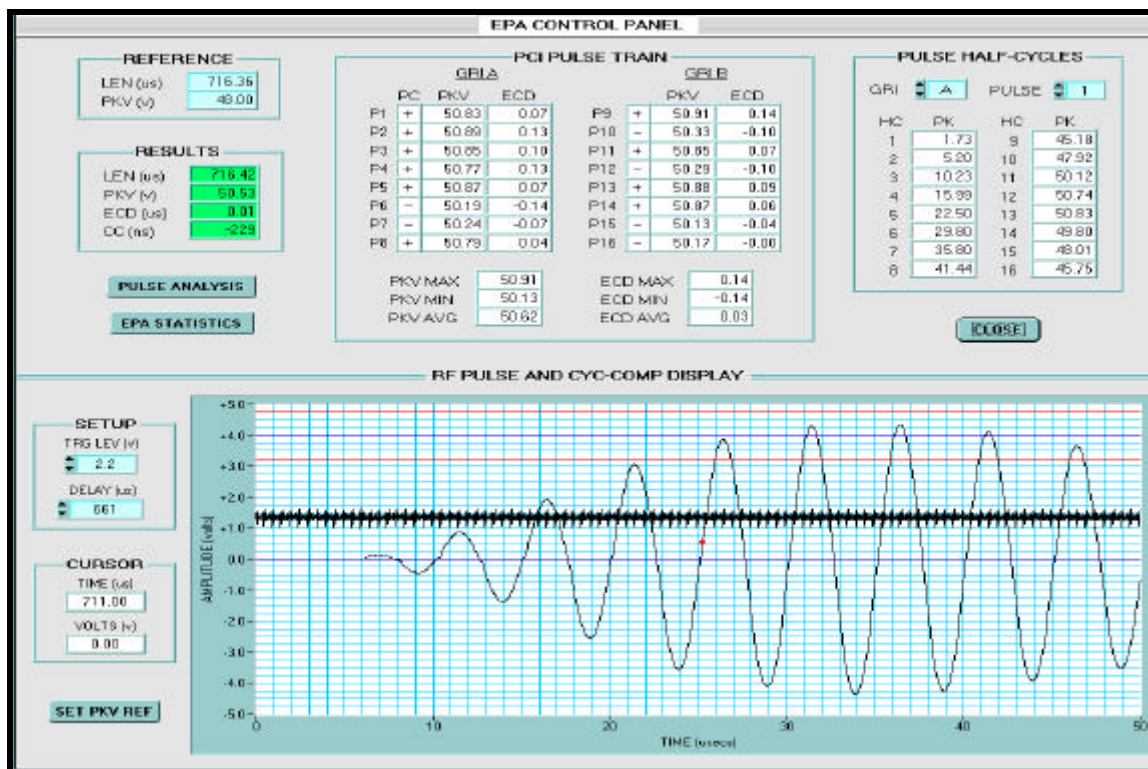


Figure 5: EPA Control Panel and the Loran-C Pulse

The oscilloscope board also monitors the cycle compensation signal, and more significantly, provides pulse analysis. Technicians at the Loran station must perform pulse analysis daily. Currently, the technician monitors the Loran pulse using an oscilloscope test instrument. The technician manually views the oscilloscope display and records the half-cycle peaks of the Loran pulse. This data is then entered into a computer program on a WSII computer. It is then printed out

and sent to the remote control station via fax. Pulse analysis using RAIL's new EPA function automates this process. The pulse analysis screen in RAIL (Figure 6) allows the technician to get the required data with the touch of a button. Human error is removed from the process making the data more accurate. This data is then automatically sent to the remote control station.

PULSE ANALYSIS: 11:56:18Z 03 OCT 2001

TRANSMITTER

LORSTA LSU

RATE NEUS (9960)

STATION VICTOR

PEAK VOLTS

MIN PULSE 50.12

MAX PULSE 50.86

% DROOP 1.45

PULSE 1

HC	PEAK	ERROR	% ERR
1	1.76	0.95	1.79
2	5.23	0.85	1.61
3	10.29	0.34	0.64
4	16.04	-0.52	-0.99
5	22.53	-0.90	-1.70
6	29.88	-0.11	-0.22
7	35.89	-0.01	-0.02
8	41.55	0.63	1.19

CALC ECD 0.054

RMS ERROR 1.201

CALC PKV 52.799

ECD DIFFERENCE

P1 - P 3/7 0.130

EQUIPMENT

ETA DIAL

PULSE SYN

XMTR SER #

CATH CURR

DROOP SET

XMTR DRIVE

PULSE 3/7

HC	PEAK	ERROR	% ERR
1	1.53	0.67	1.29
2	5.29	0.87	1.67
3	10.29	0.36	0.69
4	15.79	-0.65	-1.25
5	22.56	-0.62	-1.19
6	29.14	-0.46	-0.89
7	35.80	0.42	0.82
8	40.67	0.38	0.74

CALC ECD -0.076

RMS ERROR 1.114

CALC PKV 51.826

USE SCOPE DATA
USE ENTRY DATA

CLOSE

Figure 6: Pulse Analysis Panel

Data Charts: Critical signal data at the Loran-C transmitting station are currently recorded on paper charts. These chart recorders are maintenance intensive, plus, archiving the data requires the paper rolls be stored in a controlled environment. RAIL uses electronic charts and archives the data electronically, vastly improving the monitoring and archiving of data. (Figure 7) is an example of the cycle compensation data and the local station's Envelope to Cycle Difference (ECD) electronic charts and the Antenna Current readings.

Other Equipment Enhancements: RAIL also allows enhancements and changes in other equipment outside the Loran-C transmitting station. The remote control computer system, LCCS, required significant software modifications. LCCS communications, message queue, and parser were significantly revised to optimize operations and communications. LCCS no longer communicates with LSOS directly, but instead communicates with LSOS via RAIL. LCCS's software and GUI were changed to provide remote control of the ABS, oscillators, TTM, Locus receiver and RAIL EPA, and display the new data provided by the new equipment.

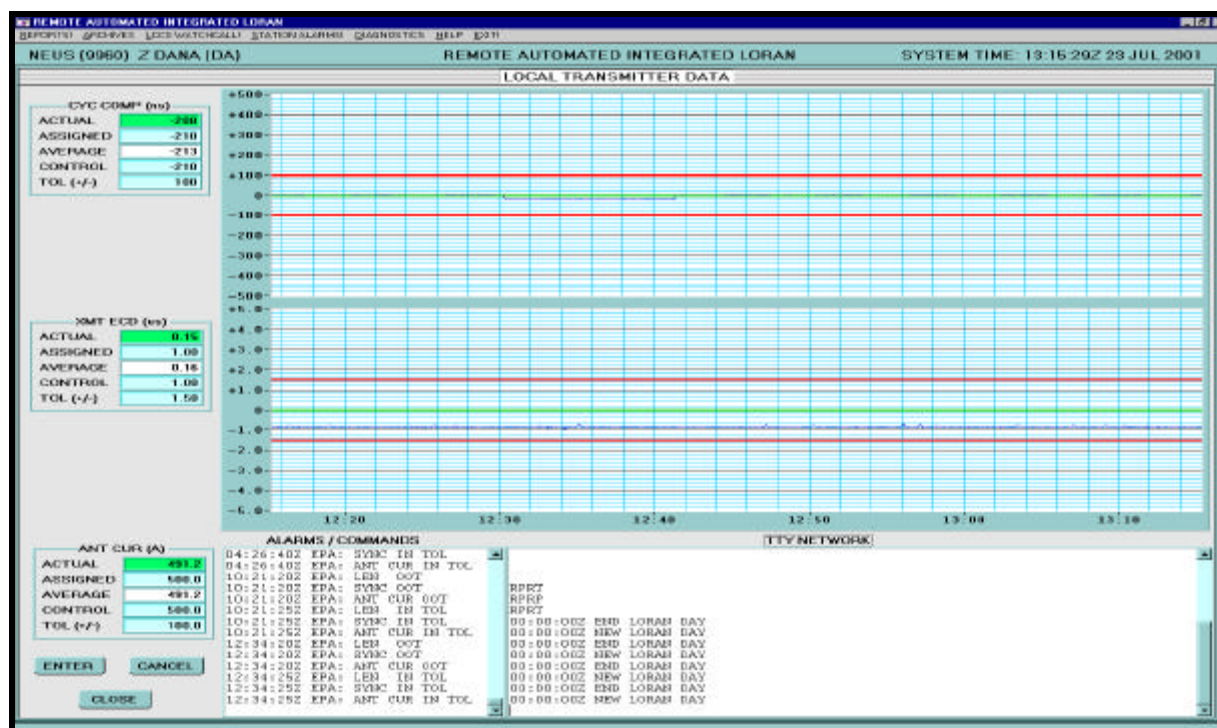


Figure 7: Data Charts

Conclusion: The RAIL system will vastly improve the operations of the Loran-C transmitting station by improving data communications, data parsing, data integrity, remote control operations, and by automating many of the functions that currently require human intervention. Rail will automatically send data required by remote control operators that previously had to be sent by a cumbersome human intensive process. Furthermore, the new equipment will replace antiquated equipment that soon will no longer be supportable due

to lack of spare parts. Finally, the new equipment uses advanced technology which will improve performance and reliability while reducing maintenance and support costs.

Correction: This article was written by LT Jim Betz, Project Engineer, LSU Wildwood Development Branch. Not by LCDR Jeff Hudkins that has been stated in the Radionavigation Bulletin Fall/Winter 2001 that is being distributed at this time. Sorry for any inconvenience.

Medals and Awards

U.S. Department
of Transportation
**United States
Coast Guard**



Commanding Officer
United States Coast Guard
Navigation Center

7323 Telegraph Road
Alexandria, VA 22310-3998
Phone: 703-313-5800
FAX: 703-313-5805

1650
JUN 26 2001

From: Commanding Officer, USCG Navigation Center
To: Officer-In-Charge, USCG LORAN Station Gillette, Wyoming

Subj: LETTER OF RECOGNITION

1. I am writing to acknowledge your crew's exemplary operational performance during the calendar year 2000, in the execution of the Coast Guard's radionavigation mission in the Eighth District. During this period, discounting authorized 'off-air' for Automatic Blink System installation and certification, your crew provided an amazing 99.994% LORAN signal availability in the South-Central U.S. LORAN Chain and 99.997% in the North-Central U.S. LORAN Chain, greatly exceeding the Coast Guard's advertised station availability of 99.90%! As a key station to the navigation coverage in the Western U.S., your technical expertise and professional competence was truly outstanding, with only four minutes of unusable time for the entire year. This was a significant achievement considering personnel transfers accounted for 50% crew turnover.
2. Central to this excellent operational record is the initiative displayed in the superb maintenance performed above and beyond what is required by the Coast Guard Preventative Maintenance System. You obtained the top rating of OUTSTANDING during NAVCEN Detachment Petaluma's annual operations inspection. LORAN Station Gillette's superior training plan, attention to detail, and aggressive maintenance program continues to set the standard for LORAN transmitting station operational performance.
3. Your ongoing assistance to other LORAN stations and the active involvement in the community of Gillette reflect highly on you and the Coast Guard and exemplifies Coast Guard core values of honor, respect and devotion to duty. The Coast Guard is fortunate to have you as members of the navigation community. BZ!!

A handwritten signature in black ink, appearing to be "T. R. Rice", written over a printed name.

T. R. RICE

Medals and Awards

U.S. Department
of Transportation

United States
Coast Guard



Commanding Officer
United States Coast Guard
Navigation Center

7323 Telegraph Road
Alexandria, VA 22310-3998
Phone: 703-313-5800
FAX: 703-313-5805

1650
JUN 26 2001

From: Commanding Officer, USCG Navigation Center
To: Officer-In-Charge, USCG LORAN Station Seneca, New York

Subj: LETTER OF RECOGNITION

1. I am writing to acknowledge your crew's exemplary operational performance during the calendar year 2000, in the execution of the Coast Guard's radionavigation mission in the Ninth District. During this period, discounting authorized 'off-air' for tower lighting overhaul and transmitter annual maintenance, you provided an amazing 99.997% LORAN signal availability to users of the Eastern Seaboard and Great Lakes LORAN Chains, greatly exceeding the Coast Guard's advertised station availability goal of 99.90%! This significant achievement was accomplished during the installation of Remote Automatic Integrated LORAN (RAIL) with three upgrades, installation of a redesigned monitoring system, repair of the station's input power breaker, and continued work towards Coast Guard self-sufficiency during the U.S. Army Depot's shut-down.
2. LORAN Station Seneca received the rating of EXCELLENT during the COCO's annual operations inspection. Central to this excellent operational record is the initiative and versatility demonstrated by your crew to obtain \$10,000 per person for training from a U.S. Army training account. You developed a strong rapport with local New York law enforcement agencies obtaining increased security patrols conducted by the county sheriff's office.
3. Your ongoing assistance to other Coast Guard units and your active involvement in the community of Seneca reflect highly on you and the Coast Guard and exemplifies Coast Guard core values of honor, respect and devotion to duty. The Coast Guard is fortunate to have you as members of the navigation community. BZ!!

A handwritten signature in black ink, appearing to read "T. R. RICE", with a large, stylized flourish above it.

T. R. RICE

Operational Status of Loran Equipment Modernizations

-An Update-

Abstract:

In January 1997, the Federal Aviation Administration (FAA) and the Coast Guard developed an Interagency Agreement for the upgrading, and modernizing the existing Loran-C System. The Coast Guard Loran Support Unit (LSU) has undertaken a number of projects, which strive towards this goal. This paper reports on those efforts, which have occurred or are coming to fruition within the immediate future. Some are currently passing the transition from engineering to operations. The following seven Loran improvement projects will be covered:

The Automatic Blink System (ABS) monitors the timing at the local transmitting station and starts proper blink secondary whenever ABS detects a 500ns or more disagreement between local timing sources. In the event of a Master timing abnormality, the master station is taken off air. This system was brought on line in June 2000.

Uninterruptible Power Supplies (UPS) have been fielded for operational testing at LORSTAs Jupiter, FL, Grangeville, LA, Carolina Beach, NC, and Malone, FL. Collectively, the Operations Room UPS, and the Transmitter Room UPS back up the entire Loran suite of equipment at a Solid State Transmitter (SSX) station until a installed Generator Set (GENSET) assumes the station load. The Operations Room UPS has been selected for installation at all SSX stations and has been installed at the aforementioned LORSTAs. The Transmitter Room UPS, which backs up the SSX, is only installed at LORSTA Jupiter and has been used as a proof of concept.

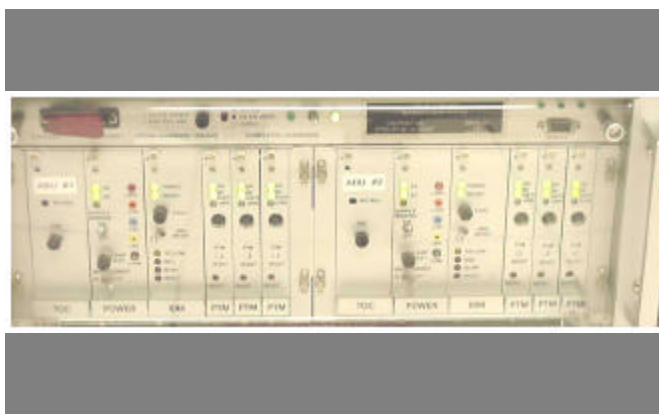
The Remote Automated Integrated Loran (RAIL) System is designed to integrate the various Loran station equipments and automate numerous functions. RAIL is designed to be the local transmitting station's command and control system and the remote interface for the Loran Consolidated Control System (LCCS). RAIL equipment is installed at LORSTAs Jupiter, FL, Grangeville, LA, Carolina Beach, NC, George, WA, and Seneca, NY.

The PDP-8 and Austron 5000 Primary Chain Monitor Set (PCMS) have been replaced with the Locus LRS-III receiver at all 29 United States and Canadian monitor sites. The Locus receivers are less labor intensive and provide a higher degree of reliability.

Three projects that are not covered under the Loran Recapitalization Project (LRP) they are the Prototype Automated Loran Station (PALS), the Equipment Control Monitor (ECM), and the consolidation of NAVCENDET Kodiak, AK and NAVCENDET Petaluma, CA. The recapitalization efforts have allowed the Coast Guard to explore de-staffing opportunities. The PALS project is testing whether a modified Loran station will allow the Coast Guard to remove staffing from a Loran station while maintaining the high degree of availability historically enjoyed by Loran-C users. The ECM provides remote monitoring and control of facility equipment at a LORSTA. The NAVCENDET Consolidation, part of Coast Guard Navigation Center (NAVCEN) reorganization, transfers NAVCENDET Kodiak's duties and responsibilities to NAVCENDET Petaluma.

This paper updates our report presented at the 2000 International Loran Association Conference in November 2000.

The Automatic Blink System



The Automatic Blink System, or ABS, was installed at all U.S. Coast Guard Loran stations and brought on line on 30 June 2000. The Federal Aviation Administration (FAA) non-precision approach requirement, calling for ten second notification of Loran-C signal abnormalities, could not be met with standard operating procedures that required human intervention at Loran transmitting stations. The initial ABS project, which began in 1991 under the auspices of the FAA, was cancelled in 1994 due to a lack of funding. In 1997, the ABS program was resurrected through upgrade and modernization efforts contained in an Interagency Agreement between the FAA and USCG. The main purpose of the ABS is to detect timing

anomalies and notify the user. It was also designed to notify transmitting station and control station watchstanders of said timing anomalies through a series of audio and visual alarms and messages. ABS also assists in filling requirements identified for un-staffed Loran Station (LORSTA) operations. From an operational perspective, two immediate benefits of the ABS are:

- **increased reliability through proper user notification of timing anomalies in less than ten seconds, and**
- **reduced risk for potential out of tolerance without proper blink caused by incorrect human intervention, equipment failures, and communications outages.**

The ABS is comprised of two redundant Automatic Blink Units (ABU) and an Automatic Blink Controller (ABC). The ABU comprises the heart of the blink functionality, monitoring appropriate inputs from the local timing receiver, three cesium oscillators, Timer Set Control (TCS), and the RF feedback loop, to determine if a need for blink exists and to start blink if necessary. The ABC serves as the interface between both ABU's and other Loran-C equipment. It is used to switch the on line functionality between the redundant ABUs. Front panel ABC controls allow for manually selecting the on line ABU and for placing the ABS in either a hardware bypass mode. The hardware bypass mode, which removes the ability of the ABS to automatically start blink, may be employed for local transmitting station maintenance of those equipment which supply inputs to the ABS. Transmitting station personnel must contact the appropriate Coordinator of Chain Operations (COCO) prior to placing the ABS into a bypass mode.

The ABS is capable of detecting timing anomalies greater than 50 nanoseconds (ns). However, due to the inherent jitter of the local transmitted signal, unnecessary blink was initiated whenever the tolerance was set below 300 ns. Therefore, the 500 ns tolerance, plus or minus 20 ns, which coincides with FAA specifications, was selected.

For secondary LORSTA timing anomalies, the ABS begins secondary blink within two seconds of a local timing anomaly. This ABS-induced blink state will continue for a minimum of thirty seconds and will continue until blink is secured by human intervention. The ABS unit will not allow blink to stop until the signal is back within the 500 ns window.

For master LORSTA timing anomalies, the ABS inhibits the timer's multi-pulse triggers, thereby taking the master off air. Without the master signal, users

throughout the given coverage area will not be able to determine their position hyperbolically.

The ABS also monitors the signal received from the other transmitting station that makes up a given baseline. This signal is used to substitute for the cesium inputs when two of those signals are missing. This allows operators to perform some of the necessary maintenance at the transmitting station without effecting the ABS unit's capabilities.

During normal operations, the ABS will synchronize itself hourly by resetting all offsets to zero. In this manner, some events such as small incremental cesium drift, local phase adjustment corrections, and small propagation time variations will be accounted for. The ABS can also be synchronized manually via the front panel or by remote control should the need exist.

An unforeseen benefit of the ABS has been identifying slight equipment problems that could lead to longer intervals of unusability or equipment down time. Intermittent faulty multi-pulse triggers activity at one of our LORSTAs resulted in ABS blink being initiated. These spikes were of such short time duration that local and remote-monitoring equipment did not detect an equipment problem. The faulty timer was repaired and brought back on line.

To date, the installed ABS throughout the Coast Guard LORSTAs have successfully initiated blink when timing anomalies greater than 500 ns have occurred. The Coast Guard has formally notified the FAA that ABS installations are complete.

Operations (OPS) Room Uninterruptible Power Supply



Until recently, loss of power to the Timer Room or Transmitter Room has resulted in Loran-C unavailability for the affected baseline. After evaluating and testing a number of uninterruptible power supplies during the past year, the Loran Support Unit (LSU) has installed APC Symmetra uninterruptible power "arrays", or supplies (UPS), at LORSTAs Jupiter, FL, Grangeville, LA, Carolina Beach, NC, and Malone, FL.

The Symmetra Power Array Master Frame system, such as the one installed at LORSTA Jupiter, is capable of providing a maximum of 16kVA. The array provides conditioned AC power and protects the installed Loran equipment in the Operations Room from input power variations resulting from surges, blackouts, and brownouts. The main components of the Symmetra array are the power processing system, a battery bank, and the control/user interface. All components of the Symmetra Array are housed within one master frame.

During normal operations, the power processing system receives either commercial or station generator set (GENSET) AC power, conditions the received power through a bank of power modules operating in parallel, and routes the conditioned AC power to the OPS Room equipment. An additional power module is installed within the master frame to provide redundancy in the event one of the power module fails. In the absence of commercial or installed GENSET AC power, the power received from the battery modules within the master frame is converted into conditioned AC power and routed to the OPS Room equipment. Hot swappable, parallel 120V battery modules supply battery power. Each battery module consists of ten 12V batteries.

The control/user interface is responsible for coordinating power up and power down states, enabling transfer between bypass states, and switching between incoming commercial or GENSET power and battery modular power. Additionally, the control/user interface runs diagnostic tests and reports the Symmetra power array status, providing both audio and visual alarms for degraded operations.

The bypass mode allows the technician to electrically remove the Symmetra from the OPS Room equipment power flow in the event maintenance of the Symmetra is warranted. During normal operation, the control/user interface reports the present load, the predicted amount of time the load could be sustained by the battery source, current individual battery module and power modules status, and displays the input and output voltage and frequency.

The control/user interface alerts the operator to a variety of alarm conditions through audio and visual alarms and messages. Alarm conditions include loss

of input power, degradation of input power, battery source enabled, loss of bypass ability, power and battery module failures, and load increases.

The Symmetra has been on line at LORSTA Jupiter since PALS testing commenced in April 2000 and at the aforementioned LORSTAs for shorter durations. According to the manufacturer's specifications, the Ops Room load was calculated to last 61 minutes. LORSTA Jupiter successfully ran the OPS Room on the UPS for 50 minutes without any power interruptions under test conditions. During periods of unstable commercial power and until an installed GENSET has taken the station load, the APC Symmetra Power Array has successfully powered the OPS Room equipment during 37 events.

Current LSU modernization efforts call for the installation of the Symmetra Power Array at more solid state transmitter (SSX) LORSTAs. Operationally, it is anticipated that availability will not be affected due to commercial/GENSET power loss, operators will be able to ascertain UPS and incoming power problems rapidly, and a reduction in time troubleshooting the variety of UPS systems currently in place will result.

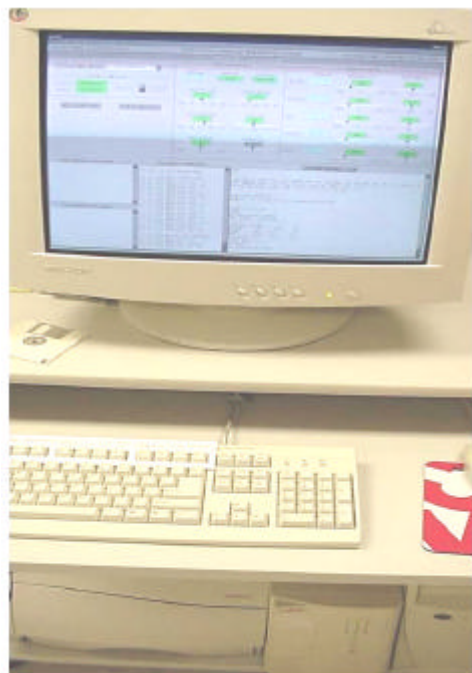
The Transmitter Uninterruptible Power Supply



A Powerware System 80, manufactured ten years ago, was installed at LORSTA Jupiter for a proof of concept test. This system, though ten years old, provided battery back up for the SSX whenever there was an interruption of commercial or GENSET power. LORSTA Jupiter ran the transmitter on the UPS for 25 minutes under test conditions: the control panel indicated another 10 minutes of power was available. During periods of unstable commercial power and until an installed GENSET has taken the station load, the Powerware System 80 has successfully powered the

Transmitter Room equipment during 37 events. LSU has identified a replacement unit and is preparing to test the unit at the LSU.

The Remote Automated Integrated Loran (RAIL) System



Another modernization project which has been fielded since the beginning of 2000 is the Remote Automated Integrated Loran system, commonly referred to as RAIL. The RAIL system is composed of Loran specific software developed by LSU and incorporated into a Windows NT system. The RAIL system centralizes numerous command and control functions previously performed by a variety of LORSTA equipment. Overall, the RAIL system has three distinct prototype phases, although some functionality is incorporated through two successive phases.

RAIL Phase I replaces the Coast Guard Standard Workstation II (CGSWII) for communications between the control and transmitting stations. RAIL interfaces operational commands, such as blink commands, and operational traffic between the equipment and operators at either end. Both course and fine control parameters are electronically digitized and recorded for current and future reference. Additionally, RAIL Phase I interfaces with the installed ABS and, where applicable, the Time of Transmission Monitors (TTM).

The home screen displays seven fields and reports the current status of all equipment interfaced with RAIL. The LORSTA's operating mode (for example,

station maintenance) and rate information for dual rated stations is displayed. The Delta field displays the current course and fine values for signal characteristics. Additionally, a cycle comp value ranging in value from -100 ns to +100 ns and a receiver amplitude value are also displayed. Double clicking on the appropriate icon allows the operator to adjust the tolerance threshold.

A value is displayed for each parameter, indicating the value's offset from center scale. The background of the value field will change between green, yellow, and red, indicating if the value is in tolerance, approaching tolerance, or out of tolerance. Similar fields for Bravo data at a master station are also displayed.

The high priority and low priority alarms fields provide messages when a LORSTA is approaching an out of tolerance condition, is out of tolerance, or is operating at reduced capabilities. The alarm commands field provides a running log of all high and low priority alarms as well as commands entered through RAIL.

The terminal window field can be used to interface with equipment connected to RAIL. Additionally, the Delta local screen can be accessed through the terminal window. This screen displays course TINO value and tolerances, digitized charts for fine TINO (also known as Master-local phase) and received signal amplitude, LOCUS receiver messages and parameters, and an alarms/commands field. Similar screens can be brought up for a Master station.

RAIL Phase II provides a local and remote interface with the Locus receiver. Back up communications with the Loran equipment is provided through Phase II. All data collection functionality currently performed by the installed Local Site Operating Set (LSOS) equipment will be accomplished by RAIL. This provides the control station watchstander easy access to LSOS for control functions, such as switching timers, as LSOS will no longer be engaged in compiling data rounds. In future Loran Consolidated Control System (LCCS) software upgrades, LCCS and RAIL will be integrated to optimize communications and operations between the transmitting and control stations, as well as allow for remote control of the LORSTAs installed Locus receiver.

Finally, in Phase III, RAIL is anticipated to replace all LSOS functionality. Phase III may automate the Loran Operations Information System (LOIS) data gathering functionality, used to analyze a variety of signal trends, via the Loran Consolidated Control System (LCCS) at the control station and RAIL. Phase III will allow the control station watchstanders to perform a variety of tasks, many of which are currently available through LSOS. One common example is the remote

switching to a variety of standby Loran equipment in the event the on line equipment fails.

Currently, RAIL systems are installed at LORSTAs Jupiter, Seneca, George, Grangeville, and Carolina Beach. Both NAVCEN and LSU have the ability to connect to LORSTA Jupiter's RAIL to check operations and run diagnostics. All data is archived and copied to a tape.

The Locus LRS-III Receiver

The Locus LRS-III receiver has replaced the CDFO-5000/PDP8 equipment at all 29 Primary Chain Monitor Set (PCMS) sites throughout the United States and Canada. All United States PCMS site receivers were swapped out during a two month period through the efforts of LSU, NAVCEN, NAVCENDET Petaluma, and NAVCENDET Kodiak personnel. The last Canadian PCMS site was swapped out 02 November 2000.

One of the main differences between the LRS-III and its predecessor is the number of chains that can be acquired and tracked. The previous generation of equipment could only process two chains simultaneously. The Locus receiver is capable of acquiring 9 chains. The control stations set up the receiver with the 8 closest chains capable of causing cross-rate interference leaving the 9th chain for the Calibration Chain.

Recent software changes have increased the receiver's capability to track 11 chains. This modification has been installed at LSU, the Cold Bay, AK and Point Cabrillo, CA monitor sites and the Navigation Center Detachment in Petaluma. To date NAVCEN Detachment Petaluma has been able to lock onto 58 baselines in 16 chains, spanning the area from the Chinese Chain (6930) to the Canadian East Coast chain (5930).

A considerable amount of effort was expended to incorporate the previous receiver's commands, report, and fault generation messages formatting into LRS-III operations. This enabled an almost seamless transition between CDFO-5000 and LRS-III control and operations and prevented the expenditure of numerous hours learning a new system at the three Loran control stations at Alexandria, Virginia and Petaluma, California.

The use of the LRS-III allows for a "plug and play" replacement for the servicing technician: in the event of failure, the entire unit is replaced and returned to the manufacturer for repair. This ability has significantly reduced lengthy troubleshooting efforts repairing an antiquated system, travel throughout the United States

and Canada to troubleshoot the CDFO5000/PDP8 suite, and significantly reduced the amount of time a chain is operated in a degraded mode of control.

Prototype Automated Loran Station (PALS)

Loran Recapitalization Project (LRP) efforts have resulted in the design, construction, installation, and operation of automated Loran equipment. These technological advances automate and simplify the day-to-day on scene requirements of LORSTA personnel. On 02 April 2000, a field test commenced at LORSTA Jupiter, FL of a Prototype Automated Loran Station (PALS). Under the PALS test, the techniques, policies, procedures, equipment, and infrastructure changes required to reduce the operating costs of a Loran station were examined. LORSTA Jupiter was selected as the test site for the following reasons:

- LORSTA Jupiter has a 32 Half Cycle Generator (HCG) solid-state transmitter (SSX). In comparison to the tube-type transmitter (TTX) used elsewhere in the Loran system, the SSX is less maintenance intensive, most of the transmitter can be repaired while the station is on air, and corrective maintenance evolutions are simpler and less time consuming than at TTX stations.
- LORSTA Jupiter is a single rated secondary station: along with the master station it comprises one baseline of one chain. The geographic area affected by outages is considerably larger for master or dual-rated secondary station casualties.
- Lightning hits have been the cause of inordinate amounts of unusable time within the Loran community. Numerous equipments can be tripped off-line and, in some cases, damaged beyond organizational and intermediate level repair. Large seasonal thunderstorms also precipitate commercial power fluctuations, which further increase the amount of unusability. Historically, LORSTA Jupiter is the worse case location for lightning strikes and commercial power fluctuations caused by inclement weather due to its location.

Under the PALS concept, operational costs are primarily reduced by:

- Addressing Loran operational and electronic maintenance concerns through an existing, nearby USCG Electronics Support Detachment (ESD)

rather than having electronic technicians attached to the LORSTA

- Addressing Loran operational and electronic maintenance concerns through an existing, nearby USCG Electronics Support Detachment (ESD) rather than having electronic technicians attached to the LORSTA, and
- Addressing Loran facility maintenance, including the installed generator set (GENSET), through a matrix of contracts and USCG engineering personnel assigned nearby.

Based upon the results of the initial PALS test period, no increases in unusable time or reduction of operational readiness outside the norm were observed. The test results showed the automation of a LORSTA is technologically feasible. The time frame of the PALS Jupiter test has been too short to accurately measure possible mean time between failures (MTBF) caused by a reduction of preventive maintenance procedures. Thus far, no detrimental effects have been noted during the one and a half year PALS test period at Jupiter. LSU has also analyzed the Canadian Preventive Maintenance Schedule (PMS) program, which calls for less frequent PMS than PALS CGPMS. No detrimental effects have been noted at the Canadian Loran systems due to a reduction of preventive maintenance.

A PALS working group, consisting of various Coast Guard units, has been convened to study the feasibility of further automations in the Loran system. During the past year, the majority of NAVCEN's efforts have been focused on providing support for non-LORAN equipment at a PALS station. In this manner, facility equipment such as the emergency generators, air conditioning and heating equipment, and fire detection and suppression systems can remain on line, be properly monitored, and supported in the event a PALS unit is de-staffed.

The Equipment Control Monitor (ECM) and the Tower Light System (TLS)

The Equipment Control Monitor is a multi-channel device that facilitates remote monitoring and control of a LORSTA's engineering plant and other ancillary equipment. ECM hardware is Commercial-Off-The Shelf (COTS) and is widely used throughout most all remote commercial broadcast facilities (AM,FM,TV) in the United States and abroad. Contract engineers at LSU have written a LORSTA-specific software application for use at a remote monitor site such as NAVCEN.

The ECM application and hardware are capable of monitoring and controlling all facility systems at LORSTAs, specifically: fire, security, tower lights, commercial primary power, GENSETs, air handlers, and UPS's. Because of the uniqueness of each LORSTA, provisions were made for a myriad of station specific alarms, sensors, and controls. Currently, the only portion of the ECM application being utilized is the Tower Light System (TLS).

In August 2001, LSU installed the first ECM and TLS units at LORSTA Jupiter. The operation of Jupiter's TLS is monitored, via the ECM, on the Master Configuration Baseline Equipment (MCBE) computer at LSU. Once initial testing at LSU is complete, a computer system will be installed at NAVCEN for monitoring TLS alarms at LORSTAs. Further funding and civil engineering work on other station facility systems is required in order to field the ECM at other LORSTAs and to fully utilize and benefit from the functionality and capacity of the ECM system.

The Tower Light System consists of a redundant photoelectric unit, controller, and annunciator. TLS hardware is COTS, specifically designed for lighting systems on Coast Guard Loran towers. Existing tower lighting systems are currently monitored remotely by the Loran Consolidated Control System (LCCS) that only provides a one alarm (good/bad) indication to the remote watchstander. The TLS however, provides the ability to determine and report all aspects of the tower lighting system. Specific alarms are provided for power failure, beacon failure, obstruction light failure, photoelectric cell failure, tower lights on/off, and alarm disabled. The additional status information will give the remote watchstander the "complete picture" of a LORSTA's tower light situation.

Navigation Center Detachment Consolidation

During the past two years the Navigation Center has examined and implemented an organizational restructuring which streamlines operations and reduces the cost of monitoring and controlling the Loran system. Until 01 June 2001, the control function was performed by three control stations located at NAVCEN, NAVCEN Detachment (NAVCENDET) Petaluma, CA, and NAVCENDET Kodiak, AK.

NAVCENDET Kodiak was responsible for monitoring the Gulf of Alaska (7960), North Pacific (9990), and Russian American (5980) Loran-C chains. These operations were shifted to NAVCENDET Petaluma on 01 June 2001. No periods of unusability or lapses in control were noted during the transition. In addition to the three chains noted above, NAVCENDET remains the

primary monitor of the North Central (8290) and U.S. West Coast (9940) Loran-C chains. This has resulted in an annual savings in approximately \$214,000 .

The authors appreciate the assistance of LTJG Randy Little and Mr. John Hartzell in the preparation of this paper.

DISCLAIMER

The views expressed herein are those of the author and are not to be construed as official or reflecting the views of the Commandant or the U.S. Coast Guard.

— CAPT Tom Rice & LT Dave Fowler, NAVCEN

Coast Guard Electronic Charting Guidance Team

(continued from page 5)

The ECGT is committed to mitigating this as a recurring pattern by engaging with future acquisitions to ensure navigation systems are carefully chosen. Now that the scope of the problem has been brought to light, the team hopes to move the Coast Guard toward a standardized scalable suite of systems.

comprehensive training plan for electronic navigation systems, and ensuring continuity of Coast Guard representation in the requisite national and international forums, among other things. The challenges continue to develop, and the future of the Electronic Charting Guidance Team promises to be both challenging and rewarding. Stay tuned for future updates!

Other issues facing the ECGT, including near-time short-range aids to navigation information on the western rivers, allowing non-SOLAS, but regulated vessels the use of electronic chart systems in US waters, a

— LT Daniel Mades, NAVCEN

Loran Data Communications (LDC)

(continued from page 6)

The LDC project is still in a proof-of-concept stage. The team accomplished a great deal of work quickly to find a modulation scheme that had the potential to meet the bandwidth requirements. More work is

needed to ensure that the LDC signal maintains the high Coast Guard standards in precise electronic navigation and timing for LORAN users.

— LT Kevin Carroll, LSU

Pueblo NDGPS Site Completed

The Nationwide Differential Global Positioning System (NDGPS) Project added its 21st operating site following the conversion of the Ground Wave Emergency Network facility near Pueblo, CO on November 1st 2001. In addition to the standard equipment, this is the first NDGPS site to receive high accuracy reference monuments, and in a cooperative effort with the University NavStar Consortium, installed choke ring GPS reference antennas and precision weather domes. These reference stations will feed information to the National Geodetic Survey's Continuously Operating Reference Station (CORS) network. An installed meteorological sensor package will feed data to the National Oceanic and Atmospheric Administration's (NOAA) Forecast Systems Laboratory.

— LCDR Gary Schenk, NAVCEN

**CGSIC 39th
Meeting Announced
April 17 - 19, 2002
Washington, DC**

The United States Coast Guard Navigation Center (NAVCEN) provides quality navigation services that promote safe transportation and support the commerce of the United States. Under the authority of 14 U.S.C. 81 and in support of the International Convention for the Safety of Life at Sea, NAVCEN is responsible for operating maritime radionavigation systems and disseminating navigation information. NAVCEN also plays a central role in facilitating the civil use of the Global Positioning System (GPS), in support of Department of Transportation goals.

NAVCEN operates and manages Coast Guard radionavigation systems from two sites - Alexandria, Virginia and Petaluma, California. With 29 transmitting and 2 control stations, the Loran - C system provides service in the continental United States and Alaska. Linked with Canadian and Russian transmitting stations, Loran - C serves marine, air, and land navigation, as well as precise timing and other scientific applications. The Maritime Differential Global Positioning System (DGPS) network of remote broadcast sites serves United States coastal areas, including the Great Lakes, Puerto Rico, much of Alaska, Hawaii and the Western River system, and provides the accuracy and performance to support harbor entrance and approach navigation. The Nationwide DGPS (NDGPS) service is expanding coverage of the Maritime DGPS service to the entire continental United States and greater portions of Alaska, and provides the accuracy and performance to support positive train control and other land applications. Currently, 73 broadcast sites provide differential corrections to maritime and inland users; 4 additional sites are scheduled for completion during the winter months of 2002.

Through operation of the Navigation Information Service (NIS), NAVCEN provides the public with information on navigation systems and other waterways safety topics. The 24- hour staff of the NIS uses the latest computer and Internet technologies to gather, process, and disseminate timely radionavigation system status, marine advisories, and other maritime information. NAVCEN also coordinates and manages the Civil GPS Service Interface Committee (CGSIC) as part of the Department of Transportation's initiative to integrate GPS use into civil sector applications. CGSIC is recognized world- wide as the forum for effective interaction between civil GPS users and United States government service providers.

As a center of navigation excellence, NAVCEN is proud to continue the Coast Guard's long tradition of supporting waterway safety and maritime commerce. Through the use of new technologies such as DGPS and NDCPS, NAVCEN will serve our nation's transportation needs well into the 21st century.

Contacting the Navigation Information Service (NIS)

Internet:

<http://www.navcen.uscg.gov>

E-Mail:

nisws@navcen.uscg.mil

GPS Status Recording:

Telephone: (703) 313-5907

WWV/WWVH Radio Broadcast:

WWV broadcasts by telephone or radio at 14-15 minutes past the hour and WWVH at 43-44 minutes past the hour. Radio frequencies: 2.5, 5, 10, 15, & 20 MHz.

Telephone: (303) 499-7111

Write or Call:

Commanding Officer (NIS)
U.S. Coast Guard Navigation Center
7323 Telegraph Road
Alexandria, VA 22315-3998
Telephone: (703) 313-5900

Coast Guard SDL No. 137

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	1	1	1		1	1	1	1	1	1		1	1	1	1	1	1		1		2					
B		10	10	3	10	2	2	5	5	2	5	3	3	3	3	2	1	5	3	1	1		2	2	5	1
C	5	3	1	5	2	3	3		1	1	3	2	1	5	1		1	1	1	1	1	2	2	1	1	1
D	1	1	1	2	1	1		1	1	1	1	1	1		1	1			1	2	1	1	1			1
E	1		1				1	1		1	1	1	1	1	1				1	1		1	1			
F																	1	1	1							
G	1	1	1	1	1																					
H																										

NON-STANDARD DISTRIBUTION: CG-31 (1), CG-56 (1), CG-64 (1)